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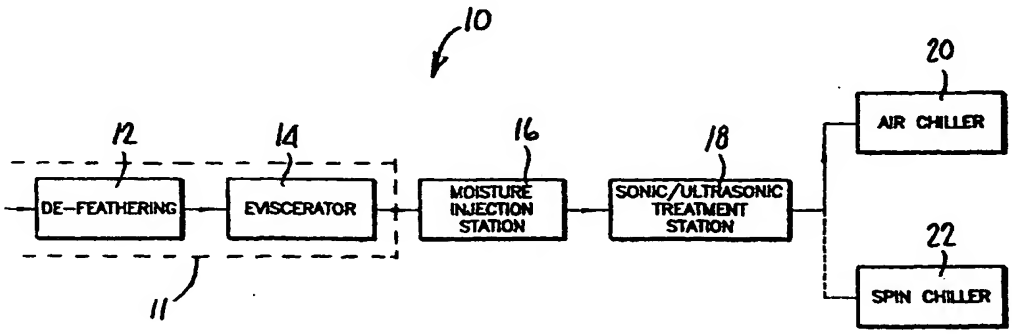
(54) Title: METHOD OF, AND APPARATUS FOR, TREATING MEAT



(57) Abstract: A method of treating the meat of a slaughtered animal (e.g. poultry) comprises adding moisture to the meat in a moisture injection station (16), and thereafter subjecting the meat to high frequency vibration in a sonic/ultrasonic station (18) prior to the onset of *rigor mortis*, whereafter the meat is cooled in an air chiller (20) or spin chiller (22).

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METHOD OF, AND APPARATUS FOR, TREATING MEAT.

This invention relates to a method of, and apparatus for, treating meat.

Meat, and more particularly chicken or other poultry meat, can be made more succulent by adding moisture to it. In the case of poultry the addition of moisture will also give the bird a plumper appearance, making it more attractive to customers. This is a permitted practice in the case of fresh poultry, provided that the amount of moisture that is added is kept below certain prescribed limits (usually 8% by weight). In the case of fresh portioned, processed, or frozen poultry, there is no limit on the amount of moisture that can be added.

However, if moisture is simply added to the meat, such as by injecting water into the meat, or by tumbling the bird carcasses in chilled water during a procedure that is known as spin chilling, much of the moisture that is added tends to be lost again later through dripping or weeping. This is so because the moisture that is added does not become bound to the other meat constituents. Even without added moisture, meat normally loses moisture through dripping or weeping, or during cooking. Furthermore, conventional injection methods tend to have one or more of the following side-effects: (1) In the case of meat with bones in it, when the needles that are used for injecting the moisture impact on a bone, water is often injected between the bone and the surrounding membrane, lifting the membrane away from the bone, creating pockets of water and blood and creating an unpleasant appearance. (2) Injecting high quantities of water often results in water being localised in areas of fat and collagen. These then expand into jelly-like pockets, giving an unnatural appearance. (3) Tumbling or massaging are sometimes employed to increase

dispersion, binding, and emulsification. These techniques tend to disturb the skin, creating an unnatural appearance and, in the case of portioned meat, the meat often separates from the bone.

It is an object of the present invention to produce meat which is succulent and tender, and in which the moisture in the meat is better dispersed and better bound to the other meat constituents, thereby reducing moisture loss through dripping or weeping, and retaining a natural appearance.

According to the invention there is provided a method of treating the meat of a slaughtered animal, which comprises subjecting the meat to high frequency vibration prior to the onset of *rigor mortis*.

The meat may be subjected to said high frequency vibration in the presence of added moisture.

The added moisture may be provided by injecting moisture into the meat prior to subjecting the meat to said high frequency vibration, or while the meat is being subjected to such vibration. The moisture may be injected by means of needles. It could, however, also be injected in a needle-less manner, such as, for example, by means of high pressure water jets which are able to penetrate the meat.

The added moisture may in the form of clean water. By "clean water" is meant plain tap water, i.e. water that is supplied by water utilities for purposes of drinking. This is the preferred method where, for example, it is desired to produce fresh poultry.

The added moisture may alternatively be in the form of a solution of salt (for example, sodium chloride) in water. In the case of poultry, this would be the case where the poultry would not be sold as fresh poultry, but rather as processed or frozen poultry. The solution may, in addition, contain a phosphate and, if desired, other substances such as, for example, a preservative, a flavouring

agent, a curing agent, sugar, an anti-oxidant, and so on. This can be used to provide a basted or marinated product.

The added moisture may further alternatively be in the form of catholyte or anolyte water.

Where the meat is that of a warm-blooded animal, the meat may be subjected to said high frequency vibration while it is still warm, and preferably still at a temperature above 28°C.

Said high frequency vibration may have a frequency of at least 5kHz.

Further according to the invention there is provided apparatus for treating the meat of an animal, the apparatus comprising slaughtering means for slaughtering the animal and cooling means for cooling the meat of the slaughtered animal, and in addition means for subjecting the meat to high frequency vibration prior to the meat being cooled by the cooling means, while the meat is still in a pre-*rigor mortis* condition.

The apparatus may further comprise means for adding moisture to the meat prior to the meat being subjected to said high frequency vibration.

The invention will now be described in more detail, by way of example, with reference to the accompanying drawings.

In the drawings:

Figure 1 illustrates, in block diagram form, apparatus for treating the meat of birds, e.g. chicken meat, in accordance with the invention;

Figure 2 is a side view of an eviscerated and de-feathered bird as it emerges from an eviscerator forming part of the apparatus of Figure 1;

Figure 3 is a pictorial view of a moisture injection station forming part of the apparatus of Figure 1;

Figure 4 shows the position of a bird in relation to a moisture

injection unit in the moisture injection station, as the bird enters the station;

Figure 5 shows the position of the bird in the moisture injection unit while water is being injected into the bird;

Figure 6 is a detail of part of the bird, showing how moisture is injected into it while in the moisture injection unit;

Figure 7 shows the birds emerging from the moisture injection station;

Figure 8 shows a bird while being subjected to sonic/ultrasonic vibration in a sonic/ultrasonic treatment station forming part of the apparatus of Figure 1;

Figure 9 is a side view of an alternative form of sonic/ultrasonic treatment station;

Figure 10 is a front view of an eviscerated and de-feathered bird, and a hand-held water injection device for injecting moisture into the meat of the bird, in accordance with another embodiment of the invention;

Figure 11 is a view in the direction of arrow XI in Figure 10;

Figure 12 is a view similar to Figure 11, but showing the water injection device in position while water is being injected into the meat of the bird; and

Figure 13 is another view of the hand-held water injection device.

Referring first to Figure 1, reference numeral 10 generally indicates apparatus for treating poultry meat. The apparatus comprises a conventional slaughter-house conveyor for transporting the birds through the various stations of the apparatus.

The apparatus comprises slaughtering means 11 for slaughtering birds, only the final stages of the slaughtering means, namely a de-feathering station 12 and an eviscerator 14, being shown in the drawing. The slaughtering means can be of

conventional construction.

From the eviscerator 14 the birds are transported to a moisture injection station 16, where moisture is injected into the meat of the birds. From the moisture injection station 16 the birds are transported to a sonic/ultrasonic treatment station 18 where they are subjected to sonic/ultrasonic vibration. The birds are subjected to sonic/ultrasonic vibration before the onset of *rigor mortis*. The slaughtering procedures in commercial plants are normally accomplished in less than 1 hour, whereas the onset of *rigor mortis* varies from 3 to 6 hours in the case of smaller animals such as poultry.

From the station 18 the birds are transported either to an air chiller 20 or to a spin chiller 22. The air chiller 20 or the spin chiller 22, as the case may be, can be of conventional construction.

Referring now to Figures 2 to 8, reference numeral 24 indicates a slaughtered and eviscerated bird, the bird being suspended from the shackles 26 of a slaughter-house conveyor 28.

The moisture injection station 16 (see Figure 3) comprises a rotating carousel which in turn comprises a series of circumferentially spaced moisture injection units 30. Each of the units 30 has a back part 32 (see Figures 4 and 5) which is fixed with respect to the carousel, and a pivotally mounted front part 34, the two parts 32 and 34 cooperating with one another in the manner of a clamshell. The conveyor 28 is arranged so that the birds enter the carousel from one direction, move 180° around the carousel, and then leave the carousel again in the opposite direction.

On that side of the carousel where the birds 24 enter and leave it, the moisture injection units are fully open, permitting the birds 24 to enter into, or leave the spaces between the parts 32 and 34. On the opposite side of the carousel, the parts 34 have moved towards the corresponding parts 32, thereby to close the

moisture injection units and hold a bird between each pair of the parts 32, 34. Figure 4 shows one of the moisture injection units in a partly closed condition, and Figure 5 shows the unit in the fully closed condition.

The movable part 34 carries a series of accurately positioned needles 36 (see Figure 6). The internal diameter of the needles 36 is ideally in the range of 0.1 to 0.9 mm. The needles 36 are arranged in such a manner that they will enter into various predetermined parts of the bird, and each penetrate the meat of the bird up to a certain depth. The depth of penetration for each needle is chosen such that the tips of the various needles do not make contact with the bones of the bird, but stop just short of the bones. This is made possible because of the uniform size and configuration of the birds normally encountered in commercial operations of this nature.

Thus, as the birds 34 pass through the moisture injection station 16 moisture is injected into the meat of the birds. The moisture can be warm, e.g. about 25°C. This maintains the temperature of the birds, delays the onset of *rigor mortis*, and slows down the deterioration of the natural phosphate levels in the meat.

The sonic/ultrasonic station 18 may be similar in general construction to the moisture injection station 16, in that it may comprise a carousel with a series of circumferentially spaced sonic/ultrasonic units (not illustrated) in place of the moisture injection units 30, each sonic/ultrasonic unit having a fixed part and a movable part which co-operate with one another in the manner of a clamshell. The movable parts of these sonic/ultrasonic units carry a sonic/ultrasonic head such as the one illustrated at 38 in Figure 8. These sonic/ultrasonic heads 38 will come into contact with predetermined parts of the bird when the fixed and movable parts of the unit close onto the bird. While the sonic/ultrasonic head is in its

closed condition, sonic/ultrasonic energy is applied to the bird.

The frequency of the applied sonic/ultrasonic energy may be in the sonic or ultrasonic range. A frequency in the order of about 5kHz to 8kHz has been found to give good results, although it can be higher. The best frequency can readily be established by experimentation. If the frequency is too low, the vibration it establishes in the meat will have little or no effect. Moreover, the vibration at such lower frequencies can present a health and safety hazard for personnel.

From the sonic/ultrasonic station 18 the birds pass to the air chiller 20 where they are chilled.

Referring now to Figure 9, there is shown an alternative form of sonic/ultrasonic apparatus 18.1 which comprises a bath 40 containing brine. The wall of the bath is cut away for purposes of illustration, to show the birds as they pass through the bath. The conveyor 28 is arranged to pass the birds 24 through the bath. The brine can be warm, e.g. about 25°C. The bath 40 is provided with a series of sonic/ultrasonic heads 42 which are mounted on the side of the bath and which operate to inject sonic/ultrasonic energy into the brine in the bath. The bath may contain clean water instead of brine. Alternatively, it may contain catholyte or anolyte water. A major advantage of catholyte or anolyte water is its ability to kill and eliminate bio-film which is a major problem in water supply systems.

The moisture is injected into the birds and the birds then subjected to sonic/ultrasonic vibration prior to the onset of *rigor mortis*. Where birds are to be produced which are to be sold as fresh chickens, the moisture that is injected into the birds in the moisture injection station 16 should be clean water. In this event, the amount of moisture injected into the birds in the moisture injection station 16 is preferably such that when the birds leave the air chiller 20 they have an added moisture content which is at or just

below the maximum permitted value, for sale of the birds as fresh chickens.

Alternatively, a solution of salt (e.g. sodium chloride) may be injected into the meat before subjecting the meat to said high frequency vibration. In the case of poultry, this would be the case where the poultry would not be sold as fresh poultry, but rather as processed or frozen poultry. The solution may, in addition, contain a phosphate and, if desired, other substances such as, for example, a preservative, a flavouring agent, a curing agent, sugar, an anti-oxidant, and so on. This can be used to provide a basted or marinated product.

Referring now to Figures 10 to 13, reference numeral 50 indicates a de-feathered and eviscerated bird suspended from the shackles 52 of a slaughter-house conveyor.

Immediately after slaughtering of the bird, and prior to the onset of *rigor mortis*, while the bird is still warm, water is injected into the breast meat of the bird by means of a water injection device 54. The device 54 has a suitably shaped body 56 which is a relatively close fit in the body cavity of the bird, and a plurality of curved needles 58 which are normally retracted into the body.

After the device 54 has been inserted into the body cavity of the bird the needles 58 are caused to extend from the body 56. The arrangement of the needles 58 with respect to the body 56 is such that when the needles extend from the body they enter into the breast meat of the bird. Because the needles enter into the meat from the body cavity of the bird, the skin of the bird is not pierced. As the needles enter the breast meat, water is injected into the meat via the needles 58. The water is clean water and up to the 8% that is normally permitted by regulation can be injected into the meat.

As illustrated in Figure 13, the device 54 can form part

of a hand-held unit 60.

Immediately after water has been injected into the meat of the bird, sonic/ultrasonic heads are applied to the bird, in the regions of the bird's breast muscles, such that the vibrations emitted by the sonic/ultrasonic heads are injected into the breast meat. This can be effected by means of a sonic/ultrasonic head similar to the one illustrated in Figure 8.

The process of the invention takes advantage of the good water-binding capacity of pre-*rigor* meat to achieve the desired results of reduced weight-loss, reduced moisture-loss and improved succulence in whole-muscle meat and carcasses.

Being polar, water is attracted to both negatively and positively charged amino acids such as are present in the meat protein myosin. If a protein has a net charge of zero, the ability of water to bind with that molecule is reduced. (Because of the various factors which may influence the overall charge or pH of the meat-water environment, it may therefore also prove beneficial under certain conditions to use catholyte or anolyte water as part of the process.) After the onset of *rigor mortis*, most of the actin and myosin combine to form the compound actomyosin, which does not have the good water-binding capacity of its constituents. (Meat processors then typically use polyphosphates to bind water, since these not only act on the available myosin in synergistic association with salt, but also assist in the dissociation of actomyosin.) This decreased water-binding capacity thus makes it desirable to bind water in carcasses prior to *rigor mortis*.

Due to the fact that it is applied prior to *rigor mortis*, the process also overcomes the disadvantages experienced by meat processors in the use of PSE meat. PSE (pale, soft and exudative) is an undesirable state which is sometimes found after the onset of *rigor*. The condition leads to severe moisture loss, and consequently

also renders the meat unsuitable for retail sale and for use in several processed products. The PSE phenomenon is associated with a variety of pre-slaughter factors including genetics and stress, and cannot normally be compensated for after slaughter. However, if water can be bound prior to *rigor*, exudation is reduced significantly or even eliminated.

The process of the invention therefore relies on the pre-*rigor* state of the meat to achieve the desired results.

It is believed that the sonic/ultrasonic energy to which the meat is subjected has the effect of (1) dispersing the added moisture, and, if present, the salt and phosphates in the added moisture, (2) assisting myosin present in the muscle fibres to be released for water-binding and (3) assisting the phosphates naturally present in the meat (or the phosphates in the added moisture) to react with the myosin and so bind the moisture naturally present in, or added to, the meat. Such moisture is less likely to be lost by weeping or dripping, or through cook-out. The sound/ultrasound has been found to have a very fast action so that the meat need only be subjected thereto for about 15 to 100 seconds, depending on the intensity of the sonic/ultrasonic energy applied, and also on the thickness of the muscle or carcass.

The final cooked or roasted product is to benefit the consumer in that there is less drying out, thus the roasted or cooked meat contains more moisture and has a natural succulence, and the meat looks bulkier.

The term "animal" in the present specification should be interpreted broadly so as to include fish. The invention can also find application in the treatment of, for example, beef, mutton, and pork.

CLAIMS:

1. A method of treating the meat of a slaughtered animal which includes subjecting the meat to high frequency vibration, **characterised in that** the meat is subjected to said high frequency vibration prior to the onset of *rigor mortis*.

2. A method as claimed in claim 1, **characterised in that** the meat is subjected to said high frequency vibration in the presence of added moisture.

3. A method as claimed in claim 2, **characterised in that** the added moisture is provided by injecting moisture into the meat prior to subjecting the meat to said high frequency vibration, or while the meat is being subjected to such vibration.

4. A method as claimed in claim 2 or claim 3, **characterised in that** the added moisture is in the form of clean water (as herein defined).

5. A method as claimed in claim 2 or claim 3, **characterised in that** the added moisture is in the form of a solution of salt in water.

6. A method as claimed in claim 2 or claim 3, **characterised in that** the added moisture is in the form of catholyte or anolyte water.

7. A method as claimed in any one of the preceding claims, the meat being that of a warm-blooded animal, **characterised in that** the meat is subjected to said high frequency vibration while it

is still warm.

8. A method as claimed in claim 7, **characterised in that** the meat is subjected to said high frequency vibration while its temperature is still above 28°C.

9. A method as claimed in any one of the preceding claims, **characterised in that** said high frequency vibration has a frequency of at least 5kHz.

10. Apparatus for treating the meat of an animal, the apparatus comprising slaughtering means (11) for slaughtering the animal and cooling means (20, 22) for cooling the meat of the slaughtered animal, **characterised in that** it further comprises means (18) for subjecting the meat to high frequency vibration prior to the meat being cooled by the cooling means, while the meat is still in a pre-*rigor mortis* condition.

11. Apparatus as claimed in claim 10, **characterised in that** it further comprises means (16) for adding moisture to the meat prior to the meat being subjected to said high frequency vibration.

12. Apparatus as claimed in claim 10 or claim 11, **characterised in that** said high frequency vibration has a frequency of at least 5kHz.

13. A method of treating the meat, substantially as herein described and illustrated.

14. Apparatus for treating the meat, substantially as herein described and illustrated.

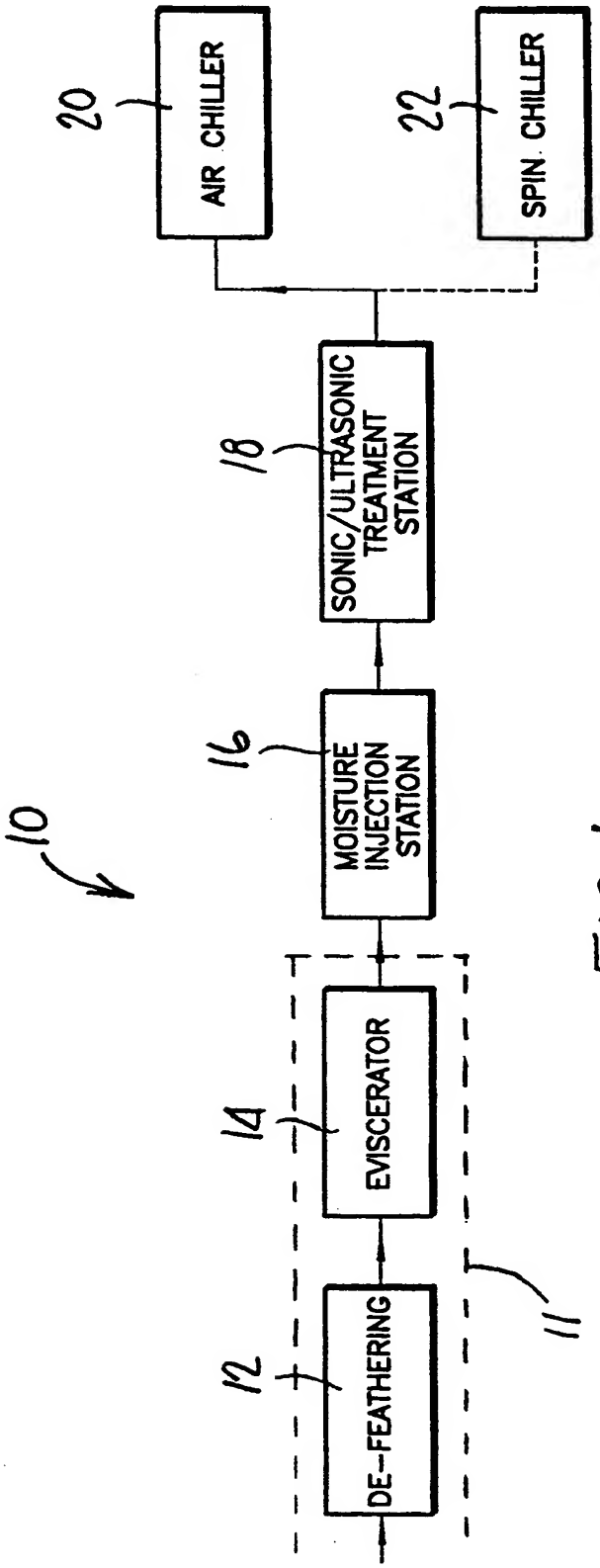

FIG 1

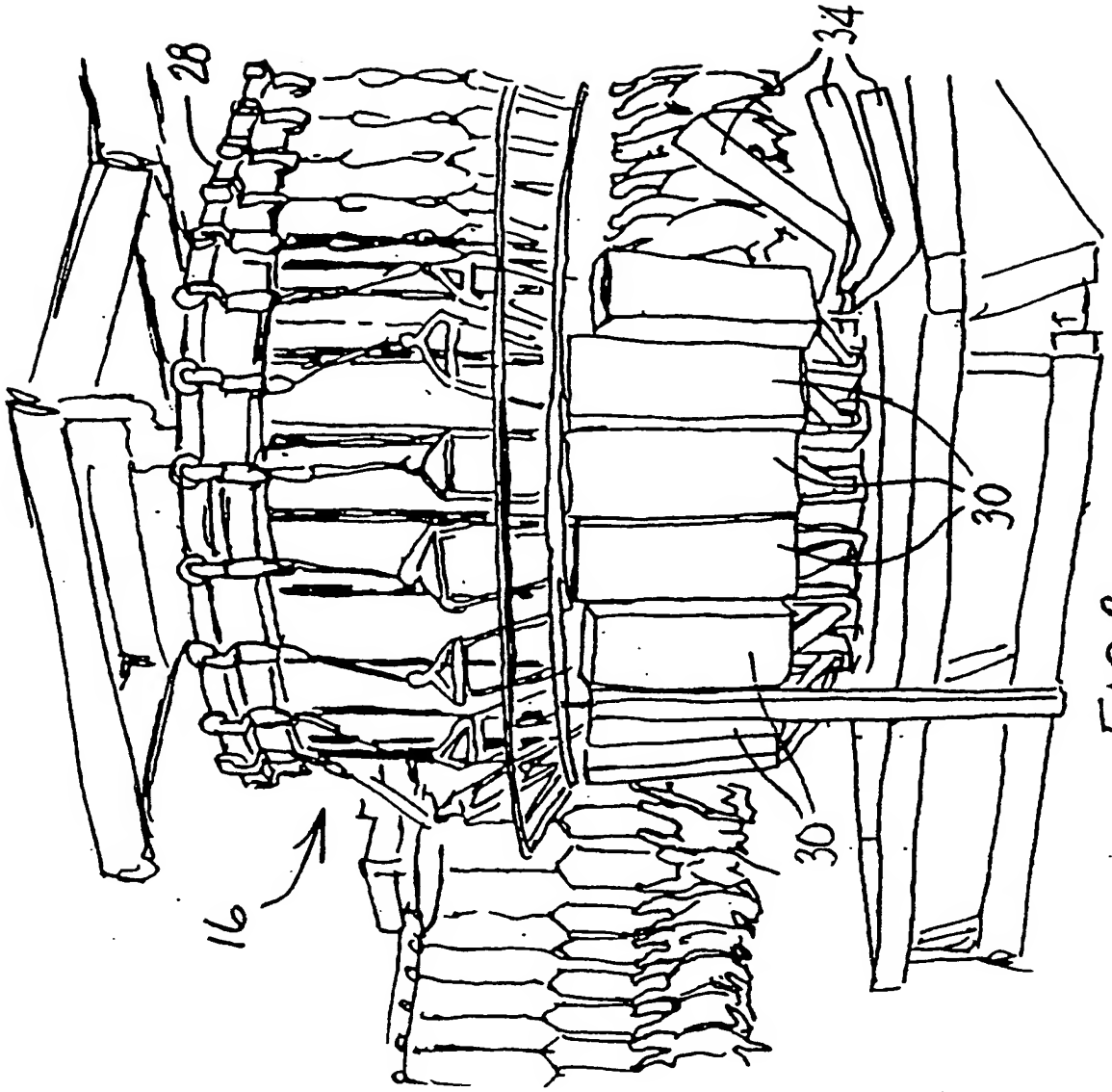

FIG 3

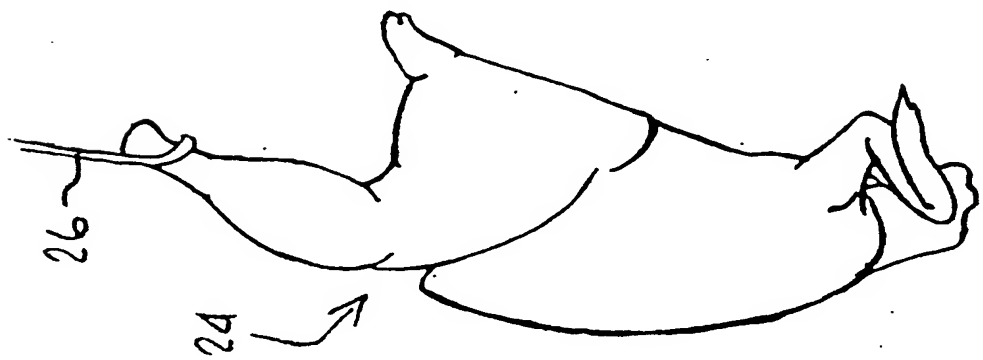

FIG 2

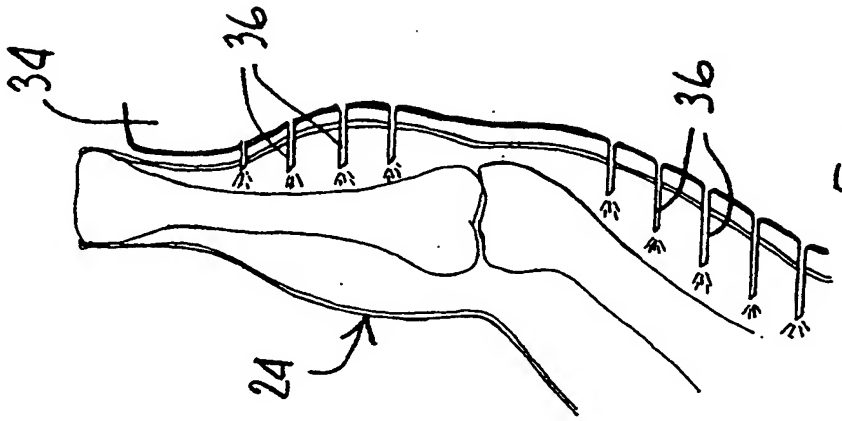

FIG 6

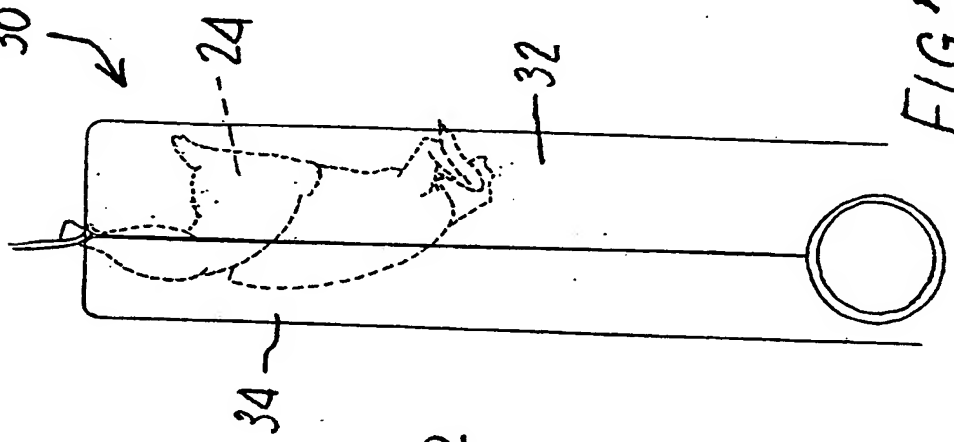

FIG 5

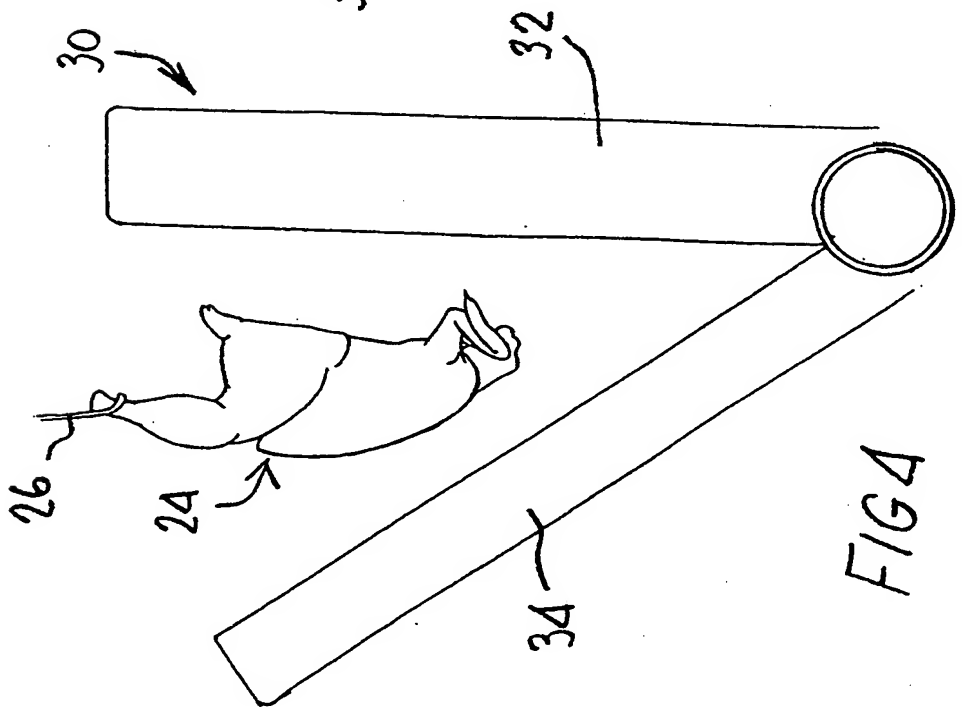

FIG 4

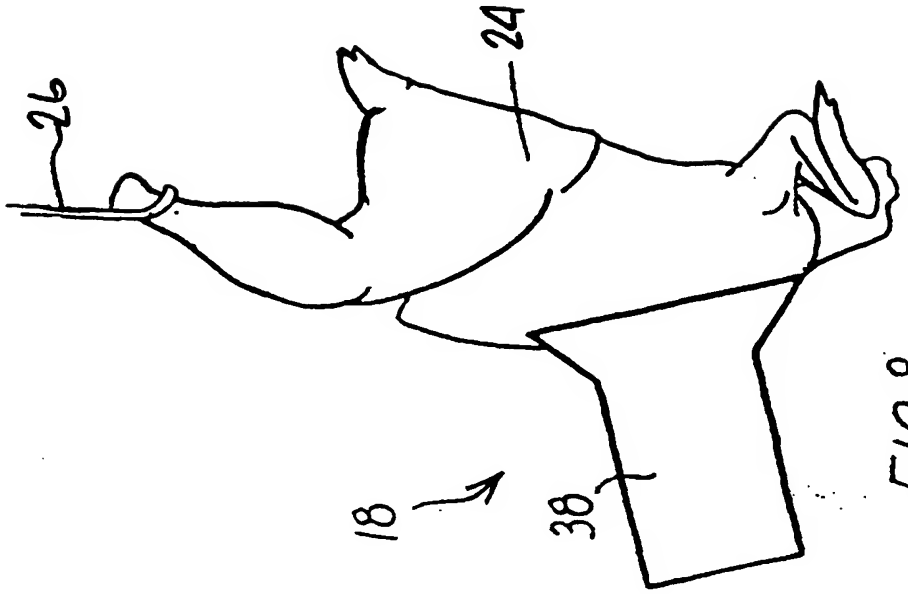

FIG 8

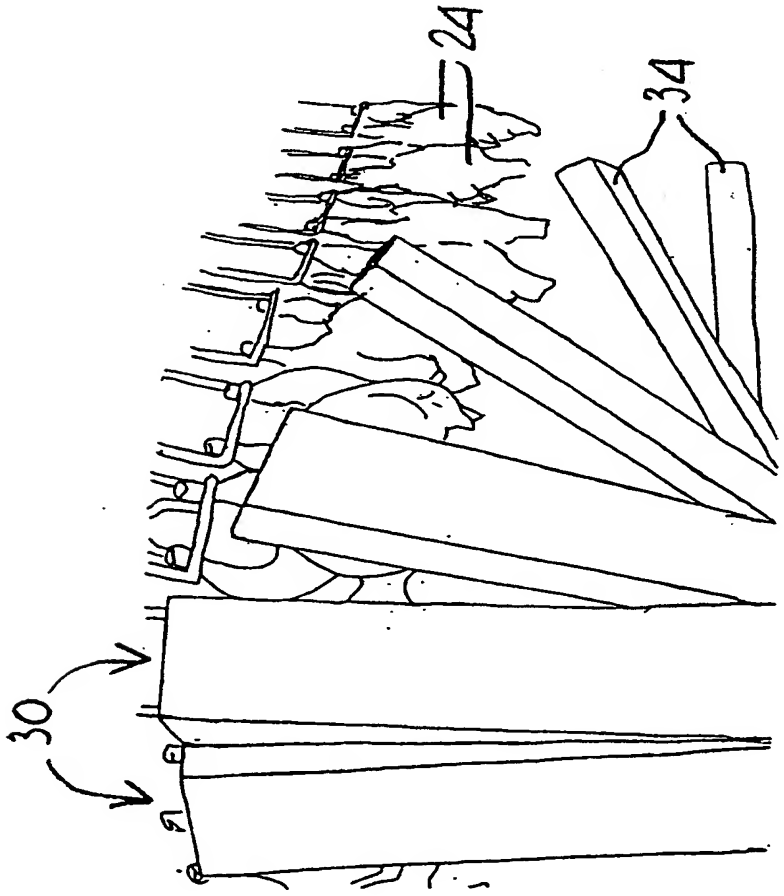

FIG 7

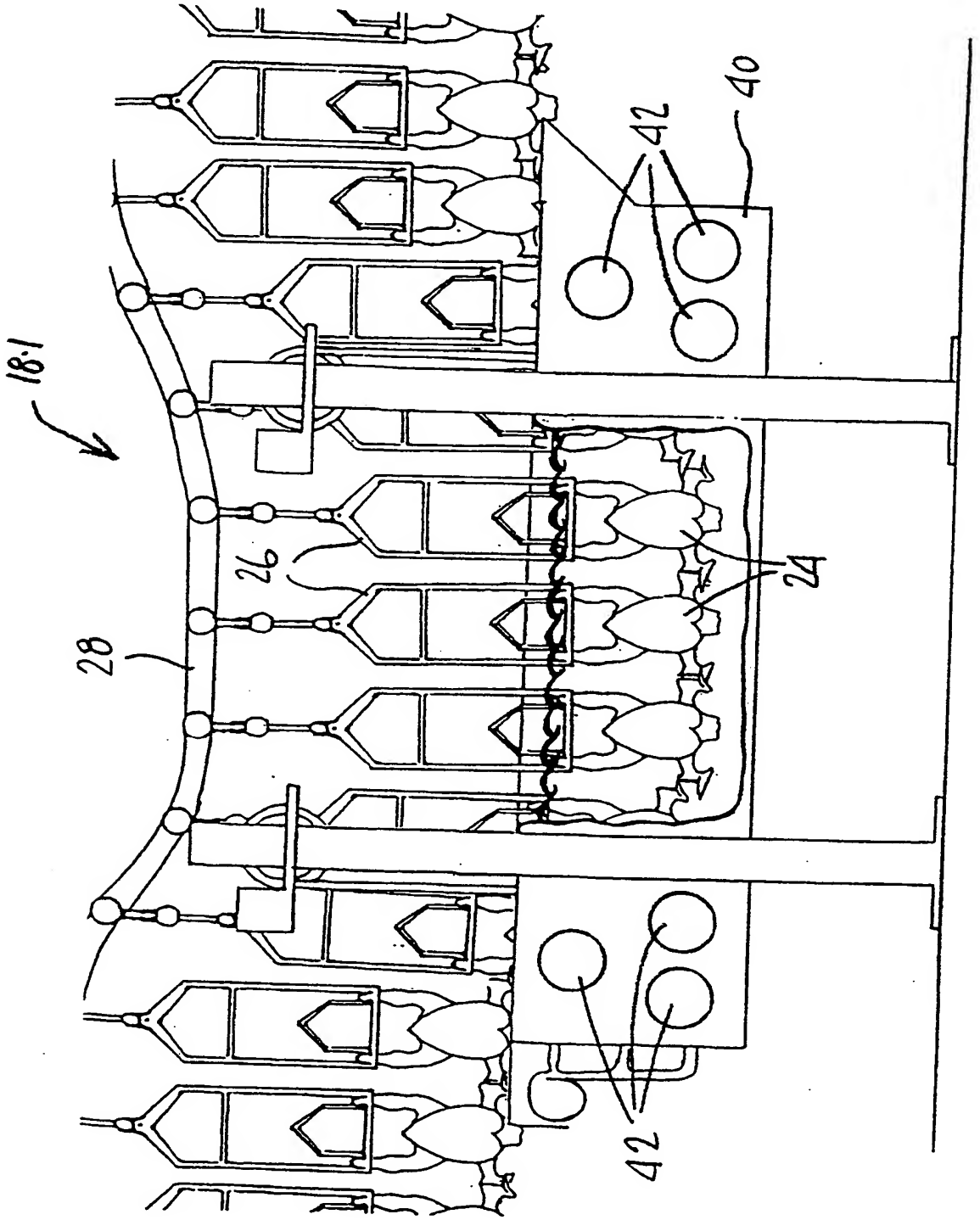

FIG 9

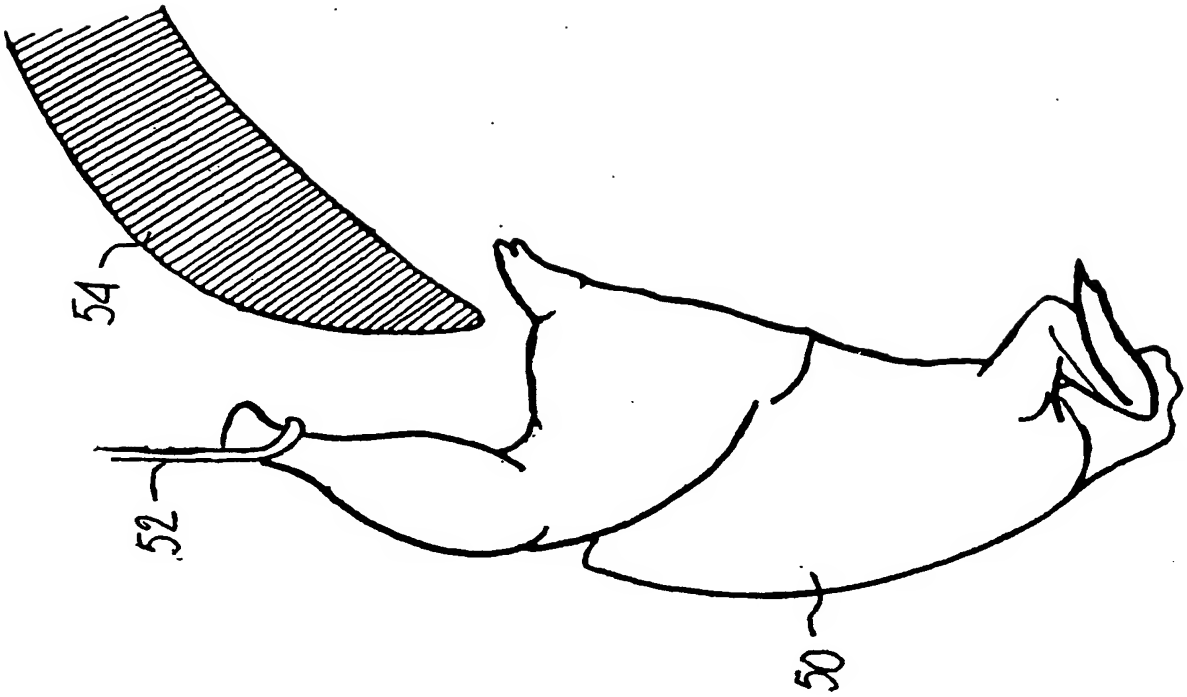

FIG 11

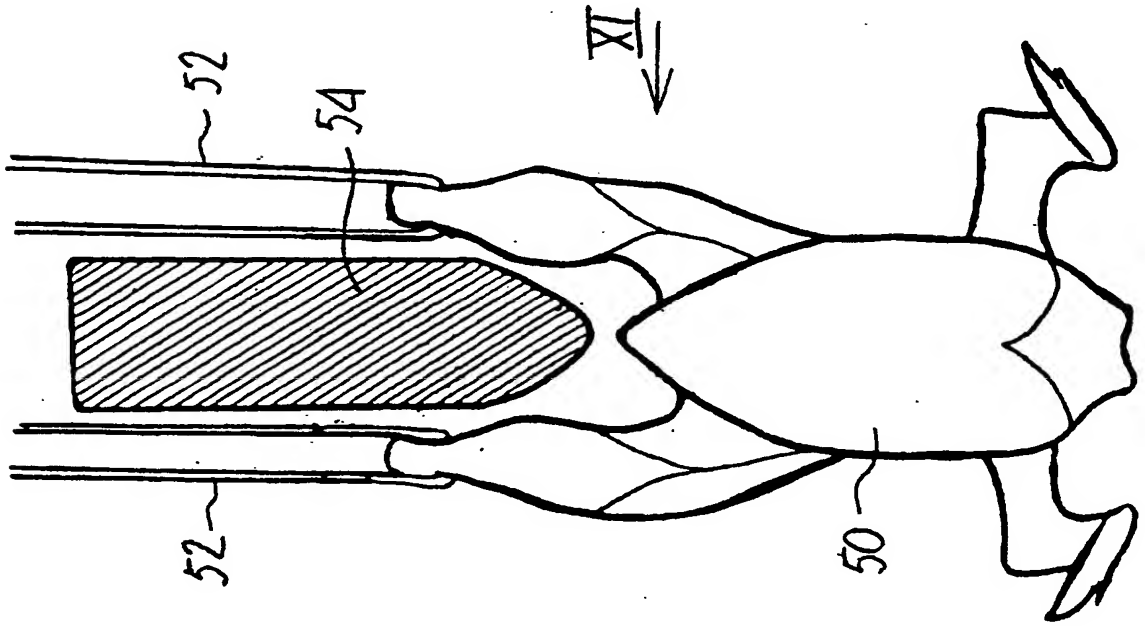

FIG 10

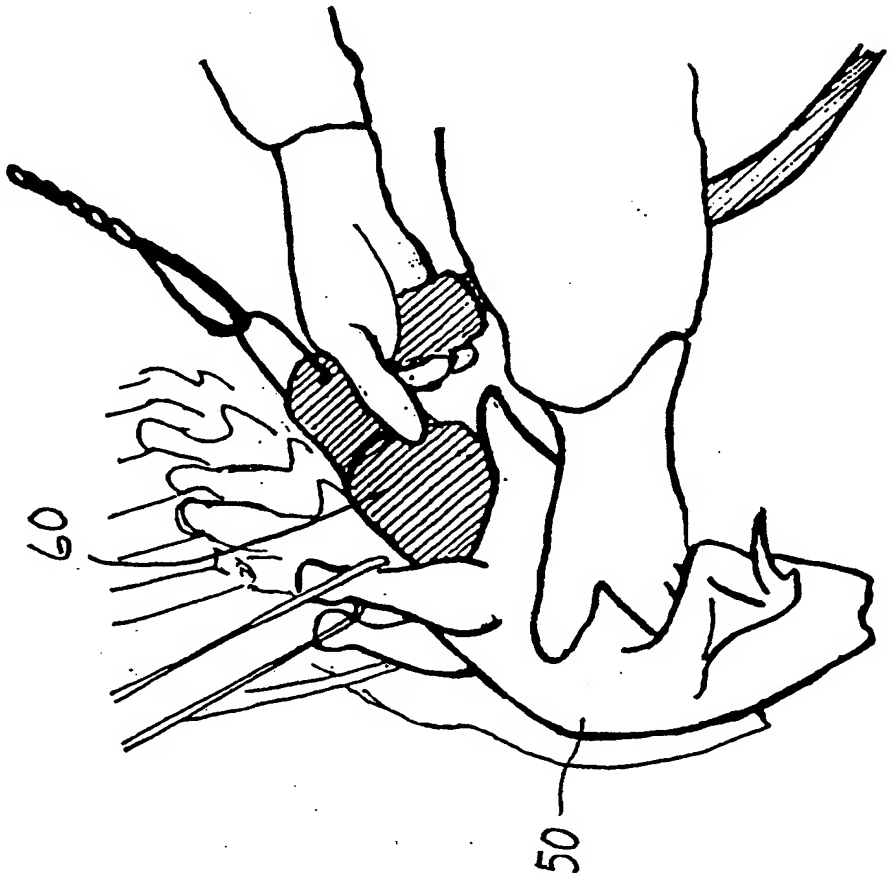

FIG 13

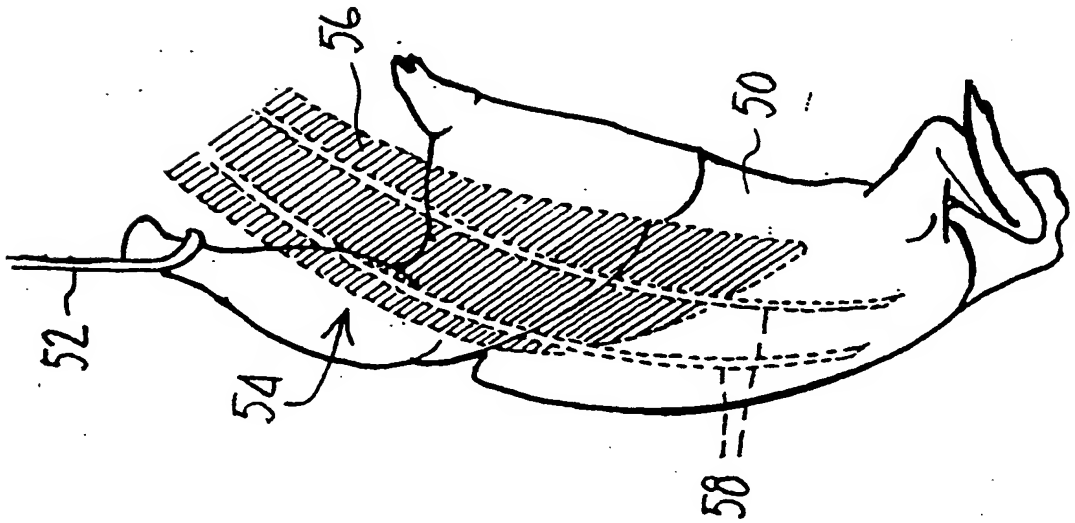

FIG 12

INTERNATIONAL SEARCH REPORT

In ational Application No
PCT/IB 00/01735

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A22C9/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A22C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 675 947 A (CLATFELTER KENNETH A ET AL) 30 June 1987 (1987-06-30) column 1, line 7 - line 10 column 2, line 48 - line 63 column 3, line 59 -column 4, line 3 column 4, line 28 - line 42 column 8, line 16 - line 20; claims 1,3; examples 4,7	1-14
Y	US 5 939 115 A (KOUNEV ZHEKO V ET AL) 17 August 1999 (1999-08-17) column 1, line 39 - line 64; claims	1-14
Y	US 3 579 716 A (STOUFFER JAMES R ET AL) 25 May 1971 (1971-05-25) column 1, line 14 - line 29 column 2, line 1 - line 16 column 3, line 19 - line 38; claim 1	1-14

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 February 2001	06/03/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Acerbis, G

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Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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